USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Natural Attenuation of Trichloroethene in Wetland Soils and Palcowetland Sediments

Duration: 7/1/97 - 6/30/98

Federal funds requested: $57,380 (total and direct)

Non-Federal funds pledged: $130,158 (total) ($71,270 [direct] + $58,888 [indirect])

Principal investigators:

Drs. Alan E. Fryar, Mark S. Coyne, and Anastasios D. Karathanasis, University of Kentucky, Lexington ('Kentucky Water Resources Research Institute)

Dr. David L. Balkwill, Florida State University, Tallahassee (Florida Wetlands and Water Resources Research Center)

Dr. Stephen A. Macko, University of Virginia, Charlottesville (Virginia Water Resources Research Center)

Congressional districts of universities performing research:

6th (Kentucky), 2nd (Florida), 5th (Virginia)

Statement of the critical regional water problems:

We propose a comparative study of the natural attenuation of trichloroethene (TCE), a common organic contaminant, within wetland soils and paleowetland sediments in the vicinity of the U.S. Department of Energy's Paducah Gaseous Diffusion Plant (PG DP). This proposal, which builds upon a study of ground-water/streams interactions currently supported through the Annual Institute Program, addresses two regional research priorities: water quality (remediation research) and aquatic and environmental pro tection (studies of wetlands). Past waste-disposal practices at PGDP, a Superfund site in McCracken County, Kentucky, have resulted in solute plumes of TCE and radioactive technetium-99 extending ~4 to 5 km within the Regional Gravel Aquifer (RGA). Ground water discharges from the RGA to wetlands adjoining the Ohio River and percolates downward into paleowetland sediments of the McNairy Formation (Cretaceous). Although there is little or no attenuation of TCE within the RGA, degradation and sorption withi n wetland soils and McNairy sediments, which are likely to be locally anoxic and relatively rich in organic carbon, may limit the spread of contamination.

Understanding the mechanisms and extent of natural attenuation is important for ecological risk assessment and development of an effective remediation strategy. Because

the Atlantic and Gulf Coastal Plains are extensively underlain by paleowetland sedi ments and covered by wetlands, natural attenuation may offer a significant regional option for remediating ground water and surface water contaminated by chlorinated hydrocarbons.

Statement of the results, benefits, and information expected:

We hypothesize that (1) the relative importance of biotic and abiotic degradation of TCE differs between wetland soils and McNairy sediments, (2) there are differences in physiological groups between bacteria in wetland soils and MeNairy sediments, (3) TCE can be abiotically reduced by sedimentary pyrite, and (4) TCE partitions more readily to lignite in the McNairy Formation than to organic carbon in wetland soils. We are collecting wetland soils from the Bayou Creek watershed and Metropolis Lake and McNairy sediments from PGDP and nearby locations (Massac County, Illinois, and Calloway County, Kentucky). We will examine degradation pathways by adding TCE to soil and sediment microcosms, bacterial cultures, and pyrite batches and by monitoring the rates of TCE disappearance and appearance of degradation products. We will use enrichments in appropriate media to determine whether culturable populations of bacteria exist in soils and sediments and, if so, which groups are numerically dominant in each environment and how they contribute to TCE degradation. DNA extracted from whole-core samples and bacterial isolates will be analyzed to document the presence of selected physiological groups in soils and sediments, regardless of their culturability. ^{13}C signatures of TCE and its daughter compounds will be measured in an effort to discriminate among biotic and abiotic degradation pathways. We will assess how abiotic degradation and sorption of TCE depend on the compositions and surface characte ristics of pyrite and organic matter, and we will determine partition coefficients from sorption isotherms.

The results of this study are likely to be locally, regionally, and nationally relevant. We are already working with Federal and State agencies, businesses, and residents of the study area in our study of ground-water/stream interactions. We intend to present findings of the proposed study at meetings attended by these parties and to submit reports to them. Results will be made available to the general public upon request after this study is completed. We anticipate that our findings will be particular ly relevant to a baseline ecological risk assessment slated for the Bayou Creek watershed. Because the impacts of ground-water contamination on surface-water ecosystems and the potential for natural attenuation are being investigated at an increasing numb er of sites nationwide, we will disseminate results by presentations at regional and national scientific meetings. Ultimately, results will be published in M.S. theses and in refereed scientific journals.